

Executive Summary

EVALUATION:	Office of Oversight Investigation
SITE:	East Tennessee Technology Park
DATES:	April-October 2000

Background/Scope

The Department of Energy (DOE) Office of Oversight, within the Office of Environment, Safety and Health (EH), conducted an investigation of the East Tennessee Technology Park (ETTP), formerly known as the Oak Ridge Gaseous Diffusion Plant (ORGD), from April through October 2000. This was the last of three investigations of gaseous diffusion plants that EH conducted over the past year at the direction of the Secretary of Energy, who instructed EH to examine concerns about past operations and work practices, and the current management of legacy materials at the three gaseous diffusion plants (Paducah, Portsmouth, and the ORGD). Investigations were conducted at each site to: (1) determine whether past environment, safety, and health (ES&H) activities and controls associated with uranium enrichment, supporting operations, and environmental restoration activities were in accordance with the knowledge, standards, and requirements applicable at the time; (2) identify any additional ES&H concerns that had not been documented; and (3) determine whether current work practices for DOE-controlled areas of the site adequately protect workers, the public, and the environment. The results of the ETTP investigation are reported in two volumes. Volume 1 addresses past activities and practices and the effectiveness of past ES&H programs in protecting workers, the public, and the environment. Volume 2 addresses current ES&H programs and practices.

The investigation of the historical programs and practices at the ORGD included a review of past operations of the diffusion cascades,

laboratories, shops, smelters, and the feed manufacturing plant; historical maintenance and modification programs; and programs and practices for worker health and safety and for the treatment, storage, and disposal of waste. The EH investigation team also reviewed potentially hazardous work that was performed for other organizations, including activities directly related to manufacturing weapons components. Organizations with ES&H responsibilities reviewed by the team included management and operating contractors, DOE Headquarters offices and predecessor organizations (i.e., the Army Corps of Engineers, the Atomic Energy Commission [AEC] and the Energy Research and Development Administration [ERDA]), the DOE Oak Ridge Operations Office (OR), and the ORGD Site Office.

The EH investigation team interviewed former and current employees; toured facilities, work areas, and site grounds; conducted environmental sampling and analysis; performed radiological surveys; and reviewed documents. Interviews involved more than 300 current and former employees, including DOE Headquarters, OR, and ORGD Site Office personnel; site contractor and subcontractor managers, supervisors, and workers; and stakeholders. Environmental samples were collected from groundwater wells and springs, surface water sources, and sediments both inside and outside the perimeter security fence; the results of this sampling program are presented in Volume 2 of this report. The investigation team also reviewed thousands of historical documents, including plans, procedures, operations logs, assessments, analyses, memoranda, medical records, radiological and chemical records, company correspondence, and historical contaminant release and health studies.

The EH investigation team identified and examined a broad range of work activities and potential health and safety hazards at the ORGD. However, due to the large number and variety of

activities and facilities at the ORGDP in over 50 years of operation and the limitations posed by incomplete records, it is expected that some activities and potential hazards might not have been identified. Other ongoing or proposed DOE EH initiatives should provide greater understanding of certain aspects of these issues, including a mass balance project, a medical surveillance project, a review of potential cross-connection of sanitary water with other site water systems, and an exposure assessment project.

Results

The historical conditions, activities, and practices at the ORGDP are in many ways similar to those identified in the recent EH investigations at Paducah and Portsmouth. However, there were also a number of conditions and activities unique to the ORGDP, which contributed to different or additional health and safety risks to workers and the public, and impacts to the environment. For example, the ORGDP is located near other major DOE facilities, such as the X-10 and Y-12 Plants, and hazardous and radioactive materials moved between these sites and the ORGDP. Another difference was that the ORGDP was built and operated during, as opposed to after, World War II, with the purpose of bringing that conflict to an end. The wide variety and scope of research conducted to support gaseous diffusion and alternative uranium enrichment technologies also distinguished the ORGDP site from the other gaseous diffusion plants. Other external influences on site policies and worker and management behavior during the early years of operation of the ORGDP were generally similar to those at the other two gaseous diffusion plants. Although production pressures diminished at the end of World War II, they continued through the subsequent Cold War years. The work at the ORGDP site was vital to the U.S. national defense, and workers, aware of this importance, took pride in serving their country. Soldiers from the Army Corps of Engineers worked alongside civilians and had supervisory and management responsibilities during 1944 and 1945. Resources for and attention to worker health and safety and protection of the environment were overshadowed by the constant emphasis on increasing production. Some degree of security classification applied to most of the equipment, materials, processes, and products at the site, and “need to know” was a cornerstone of security policy. Although the “need to know” protected secrets, it also impeded the flow of information about hazards and risks at the site.

The pay and opportunities for advancement at the expanding ORGDP site were very attractive to the area workforce. These elements—pride of service, production priorities, security, and job opportunity—resulted in a climate where workers were not inclined or encouraged to question working conditions or supervisory authority. Many former workers interviewed by the investigation team indicated their perception that asking too many questions or expressing concerns about health or safety matters, formally or informally, might result in some form of retribution, typically an assignment to an undesirable job or location. To these workers this was retribution, and although it was not official, it was nonetheless perceived as overt.

The workforce was unionized after World War II, and although thousands of grievances were filed during the first 40 years of operation, safety and health issues were only a small fraction of reported concerns. The three short, authorized strikes at this site were related to wages. ORGDP suffered many more fatalities than Paducah or Portsmouth, most resulting from falls, heavy equipment operation, hoisting and rigging, electrocution, heat stroke, asphyxiation, auto accidents, and lightning strikes. Many of these occurred during the early years of intense construction activities. However, after the 1940s and 1950s, the overall frequency and severity of accidents declined, comparing favorably with industry and contractor-company rates. This is notable, recognizing that many of the ORGDP facilities were first-of-a-kind operations, with limited pilot plant testing.

During operations, maintenance, and waste management activities at the ORGDP, workers were exposed to numerous physical, radioactive, and chemical hazards. Physical hazards included heat, noise, rotating equipment, and vehicles. Workers were exposed to a wide variety of chemical and toxic metal hazards that included lead, nickel, asbestos, solvents, acids, mercury, arsenic, beryllium, chromium, epoxy resins, fluorine, fungicides, herbicides, biocides, and polychlorinated biphenyls (PCBs). Radiological hazards included uranium compounds, uranium decay products, transuranics (plutonium and neptunium), and fission products, including technetium. Facilities housing hazardous activities included the five major cascade buildings; a feed manufacturing plant; disassembly, decontamination, and cleaning facilities; maintenance buildings; uranium recovery facilities; numerous laboratories, pilot plants, and test facilities; the barrier manufacturing plant; smelters; and

incinerators. Although operation of the barrier manufacturing plant remains classified, the hazards to which workers were exposed (inhalation of materials) were similar to those hazards that were encountered at other Plant facilities. Hundreds of accidental releases of uranium hexafluoride (UF_6), hydrogen fluoride, and other hazardous materials occurred, often resulting in release to the environment; some contaminants migrated outside the Plant boundary. In many cases, personnel in the vicinity of these releases were not wearing sufficient protective clothing or equipment and suffered burns and respiratory problems that required medical treatment or monitoring.

Two other major prototype uranium enrichment processes at the ORGDP site exposed workers to hazards and contaminated the environment: the thermal diffusion project, known as the S-50 or Fercleve Plant, built and operated as a separate project in 1944 and 1945; and the gas centrifuge project, developed and tested between 1960 and 1985. Also unique to the ORGDP were diffusion barrier research, development, and manufacturing activities, conducted from 1943 through 1982, which supported all three gaseous diffusion plants. Workers at the ORGDP performed many projects for various civilian and government organizations, involving research, engineering, fabrication, testing, repair, decontamination, and plating. Much of this work for others exposed workers and the environment to various hazards and contaminants. Records, assessments, and interviews with former workers indicate that adequate personal protective equipment was not always specified to protect the workers from exposures to hazardous materials at the ORGDP and that the workers' use of such equipment, when specified, was often inconsistent and poorly monitored and enforced by supervisors.

It is impossible to fully characterize workers' exposure during the 53 years under investigation, because of past inadequate surveys and incomplete records of the work environments for the variety of facilities, activities, and hazards present in the large number and types of facilities at the site. The available information indicates that the greatest exposures to internal and external radiation were received by workers in the feed manufacturing plant; chemical operators performing decontamination, cleaning, and uranium recovery; and maintenance personnel working on removed process equipment. Most radiation exposure received by ORGDP workers was from their inhalation of airborne uranium. Although highly radioactive transuranics and fission products in normal feed and process materials did contribute to worker exposure,

they were much more hazardous when they were concentrated by some Plant processes. The concentration of transuranics was particularly high in the residual material collected in fluorination tower ash receivers and barrier filters during production of UF_6 , and high concentrations of the fission product technetium were found inside the purge cascade and some Plant instruments. Chemical operators and maintenance personnel received the greatest exposures to these materials and to chemical and physical hazards.

During the first few years of Plant operation, both the Corps of Engineers and Carbide recognized that there were significant health and safety hazards involved with the handling and processing of radioactive materials and other hazardous chemicals at the ORGDP. This recognition was especially pronounced with regard to criticality safety concerns, as Army and university scientists and engineers identified and codified the structural and operating conditions and controls needed to prevent an inadvertent criticality during implementation of this new technology. The site established formal health and safety programs during design and construction of the ORGDP. Until 1953, health and safety personnel specified the requirements and controls and performed monitoring and oversight of work activities. In 1953, new Carbide Company policy assigned responsibility for many of these functions to the line organization, with the health and safety professionals acting as advisors and performing limited audits and assessments. Insufficient resources were provided to perform effective oversight of industrial hygiene and health physics programs. Records from the early years of Plant operations and interviews with former workers indicate that contamination levels increased, personnel exposure controls were reduced, and Plant conditions and overall ES&H performance deteriorated under this policy. The policy continued until the 1970s, when increasing environmental and occupational safety regulations induced the expansion of the staffing and roles and responsibilities of the ES&H organizations. Line supervision had the ultimate responsibility for hazard identification and communication, which they typically implemented through on-the-job training and safety meetings. From Plant startup until the late 1980s and early 1990s, hazard communication activities consisted of publication of a safety handbook/manual and periodic health and safety bulletins, and limited formal training for supervisors and some hourly employees. Although procedures and job safety analyses (JSAs) did identify hazards and controls for some activities, interviews with workers indicated that

procedures and JSAs were seldom used in the field. Overall, the communication of hazards at the ORGDP was insufficient to consistently protect the workforce from all hazards.

Plant limits for airborne and surface contamination and radiological exposures to workers were established and monitored regularly. Portable and fixed monitors were available in many areas for personnel monitoring, and records indicate that contamination above limits was commonly detected on workers' hands, feet, and clothing during these checks, which were mostly voluntary. However, line management corrective actions to address the cause of contamination problems were not always timely or effective. The site established a generally rigorous program to monitor personnel exposure to internal and external radiation. Film badges and thermoluminescent dosimeters were used to monitor external exposures. Urinalysis and in-vivo (lung counting) monitoring were systematically used to monitor internal exposures resulting from inhaled or ingested uranium compounds. If specified limits were exceeded, follow-up testing was conducted, and in some cases job restrictions were imposed. However, for radionuclides other than uranium-235, the accuracy of the in-vivo testing equipment was questionable. Further, in 1964 and 1965 alone the limited available records show numerous excessive inhalation exposures, with at least five individuals receiving significant exposures (5 to 15 rem). Beginning in 1946, the site also monitored worker exposure to various chemicals, using area air sampling, worker breathing zone sampling, direct reading instrumentation, and blood and urine analysis. However, the health effects of several widely used chemicals to which workers were exposed (e.g., asbestos and PCBs) were not well known until the 1970s, and thus these chemicals were not sampled. Initially, the occupational medicine program was extensive and vigorous. However, its effectiveness declined with reductions in staffing and deterioration of facilities and equipment in the late 1950s. Deficiencies in medical program resources and operations continued into the 1990s.

ORGDP operations have released a variety of contaminants into the environment through stack and diffuse air emissions; from liquid discharges into ponds, ditches, and rivers; through accidental releases; and from past waste disposal practices, such as the burial of low-level and hazardous waste. Solid waste generated during construction and operations, including sanitary, hazardous, and radioactive materials,

were disposed of in various ways. Methods included burial in any of several landfills, pits, and holes; shipment to offsite disposal areas; open burning; burning in a succession of incinerators; land farming or road dust control using PCB-contaminated waste oils; dumping directly into onsite ponds or the Clinch River; and storage pending final disposition. Ash from the incineration of radioactively contaminated waste was processed to recover the valuable uranium. Liquid wastes also were disposed of in a variety of ways. Many process releases were held up or recovered through wastewater treatment and recovery systems. However, numerous discharges from ORGDP operations flowed directly to various Plant outfalls, ponds, and storm drains and subsequently into Mitchell Branch, Poplar Creek, and the Clinch River. Many contaminated release paths were not adequately monitored or controlled until new Federal clean-water regulations were established in the early 1970s, and many storm drains were not monitored before 1992. Routine and accidental releases of liquid wastes have adversely impacted the environment and the aquatic habitat in the streams and rivers surrounding the Plant, and have contaminated onsite discharge pathways, surface streams, and ponds. Radionuclides from upstream sources, such as the Oak Ridge National Laboratory, have infiltrated the ORGDP sanitary water distribution system for decades, typically as periodic spikes resulting from specific releases. The concentrations of this contamination have been monitored and documented regularly. Records confirm that radioactivity levels at times exceeded today's drinking water standards. Short-term (periodic) consumption of water at concentrations even greatly exceeding the standards would not be expected to pose significantly increased risks to personnel, since the standards are based on daily, long-term consumption as the primary drinking water source. Site studies have also shown that the sanitary water system was subject to potential contamination from cross-connections with other Plant water systems, including fire protection water and cooling water. Although numerous anti-siphon and backflow prevention devices were installed in the Plant sanitary water system in 1983 and 1984, personnel consuming drinking water in prior years were at increased risk of infrequent exposure to contaminants from other Plant water systems. Based on the limited amount of monitoring data reviewed during the investigation, a more exhaustive study of all available data on the occurrence of periodic spikes from releases, as well as consumption rates and potential long-term effects, may be warranted.

From the beginning of production, the Plant released radioactivity and fluorine/fluoride to the environment by accidental releases and operations-related emissions from numerous laboratories, process buildings, and incinerator vents and stacks. Several major emissions studies have been performed, but the accuracy of their conclusions is limited by past inadequacies in the monitoring and reporting of accidental releases and the difficulty of identifying all pertinent historical release data. Estimated airborne emissions were much higher in some early years, typically due to significant accidental release events. There were also significant airborne releases of UF₆ from the operation of the thermal diffusion process at the S-50 project in 1944 and 1945. Plant-wide, an estimated total of 16,000 kilograms of uranium (approximately 11 curies) and approximately 140 curies of technetium were released from 1953 to 1988. Tens of thousands of pounds of fluorine and hydrogen fluoride were emitted annually in the 1950s, and a study in 1957 identified vegetation damage due to these emissions. Emissions to the atmosphere decreased after the feed manufacturing plant was shut down in 1961.

Large amounts of salvageable scrap materials were sold at public auctions or melted into ingots, at onsite or offsite smelters, for sale or for reuse as raw materials for manufacturing Plant equipment. The ORGDP had policies and requirements for monitoring and dispositioning this material, which could be contaminated by radioactivity. However, records and interviews indicate that contaminated items were not always kept separate from uncontaminated ones, and too few health physics staff were assigned to perform pre-release surveys to ensure that no material exceeding the radiological release guidelines would be allowed off site.

Well into the 1980s, oversight of ES&H conditions and performance at ORGDP was neither proactive nor rigorous. Assessments of ES&H by the Federal agencies

responsible for ORGDP and the operating contractors were few and limited in scope during the operation of the ORGDP. Typically, one or two persons from the Oak Ridge office of AEC/ERDA/DOE conducted three- or four-day annual formal functional area assessments. Similarly, site industrial safety, industrial hygiene, and health physics organizations conducted formal audits and assessments annually and conducted less-formal surveillance activities more frequently. These assessments often identified weaknesses in ES&H staffing, the use of personal protective equipment, and industrial safety programs. However, records indicate that AEC/ERDA/DOE were active in helping the contractor develop ways to comply with emerging occupational safety and environmental regulations in the 1970s and 1980s.

Conclusions

National defense issues and economic conditions, as well as early industrial practices, greatly influenced historical management ES&H policies, operational practices, worker safety and health performance, personnel exposures, and environmental contamination. Although efforts were clearly made to protect workers and the environment, production priorities took precedence over ES&H considerations. Consequently, ES&H staffing was minimal, hazards were not always communicated well to workers, controls were often inadequately specified or applied, and unnecessary exposures and environmental contamination resulted. In addition, until the 1980s, ES&H oversight by AEC/ERDA/DOE and the contractor was insufficient to identify and correct many program and performance weaknesses. Increasing external oversight and new Federal and state environmental and industrial safety regulations in the 1970s and 1980s resulted in the improvement of site policies and practices for protecting workers, the public, and the environment.

1.1 Purpose and Scope

The Department of Energy (DOE) Office of Oversight, within the Office of Environment, Safety and Health (EH), conducted an investigation of the East Tennessee Technology Park (ETTP) from April through October 2000. The purposes of this investigation were to (1) determine whether past environment, safety, and health (ES&H) activities and controls associated with uranium enrichment, supporting operations, and environmental restoration activities from initiation of ETTP operations in 1943 until 1997 were in accordance with the knowledge, standards, and local requirements applicable at the time; (2) identify any additional ES&H concerns that had not been documented; and (3) determine whether current DOE and DOE contractor work practices for DOE-controlled areas of the site adequately protect workers, the public, and the environment. This investigation was performed at the direction of the Secretary of Energy, who instructed EH to examine concerns about past operations and work practices, and current management of legacy materials at ETTP.

The activities at ETTP are being evaluated as a single, integrated investigation coordinated with other organizations that have regulatory authority at ETTP, including the State of Tennessee, and the Environmental Protection Agency (EPA). The scope of the investigation includes: (1) ES&H practices associated with operating and support facilities and restoration activities from 1943 to 1997; (2) ES&H issues associated with these activities, facilities, and properties; and (3) facilities and properties under current DOE jurisdiction. Volume 1 addresses historical activities from 1943 to 1997. Volume 2 addresses current practices (1998 to present).

Specific ETTP operations examined by the EH investigation team include: cascade operations; feed production; oxide conversion; thermal diffusion and centrifuge operation; laboratories; landlord infrastructure activities; treatment, storage, and disposal of legacy and newly generated waste; site remediation; uranium hexafluoride (UF₆) cylinder storage; maintenance;

facility decontamination and decommissioning (D&D); and polychlorinated biphenyl (PCB) collection, treatment, and cleanup.

This investigation also examined the programs and activities of the organizations historically and currently responsible for ensuring protection of the workers, the public, and the environment at ETTP. These organizations include the Oak Ridge Operations Office (OR), the ETTP Site Office, the Carbide and Carbon Chemicals Corporation and subsequent management and operating contractors, Bechtel Jacobs Company, BNFL Incorporated, Decon Recovery Services of Oak Ridge, LLC (DRS), East Tennessee Materials and Energy Corporation (M&EC), and key subcontractors. The large number of subcontractors conducting work at ETTP made examination of all such organizations impractical; the subcontractors that were selected were those performing activities related to the DOE ES&H mission at ETTP. While this investigation did not evaluate day-to-day operations of the Toxic Substances Control Act (TSCA) incinerator, radiological emissions from this facility were examined as part of determining ETTP sitewide releases. Elements of the process by which DOE transfers facilities to the Community Reuse Organization of East Tennessee (CROET) for leasing were evaluated; however, the activities of commercial operations that lease onsite space from CROET and whose services do not support the DOE mission at ETTP were not examined. In addition, the results of other related evaluations being conducted by DOE—such as the mass balance, exposure assessment, and medical surveillance projects—are outside the scope of this investigation.

1.2 Operations and Hazardous Materials

The ETTP, formerly known as the Oak Ridge Gaseous Diffusion Plant (ORGDP), occupies 4,689 acres (7.6 square miles), or 14 percent, of the Oak Ridge Reservation and is approximately 13 miles west of the main population of the city of

Oak Ridge, Tennessee. The current site configuration is the product of past missions and programs, the most significant of which was the ORGDP (commonly referred to as the K-25 Plant), which operated from before the end of World War II until 1985. ETTP is composed of almost 400 buildings totaling approximately 14.4 million square feet. Of this, almost 90 percent (12.5 million square feet) consists of buildings that are currently undergoing, or are planned for, D&D. These buildings include the shutdown gaseous diffusion production facilities and gas centrifuge enrichment and ancillary buildings. ETTP also operates a TSCA-compliant incinerator, which handles radioactive, hazardous, and uranium-contaminated PCB wastes. Of ETTP's total building area, only 3 percent (390,000 square feet) is less than 20 years old; most buildings are 30 or more years old.

ETTP was originally built as the home of the ORGDP and was part of the Army's Manhattan Project. Its mission was to produce highly enriched uranium for nuclear weapons. After military production of highly enriched uranium was concluded in 1964, the two original process buildings (K-25 and K-27) were shut down (with the exception of two sections of each building, which operated as successive "purge cascades"). For the next 20 years, the site's primary mission was to produce only slightly

enriched uranium to be fabricated into fuel elements for government and civilian nuclear reactors. Other missions during the latter part of this 20-year period included development and testing of the gas centrifuge method of uranium enrichment and research and development (R&D) of laser isotope separation. By 1985, demand for enriched uranium had declined, and the remaining gaseous diffusion cascades in operation were placed in standby mode. In that same year, the gas centrifuge program was canceled. The decision to permanently shut down the diffusion cascades was announced in late 1987. ORGDP was renamed the Oak Ridge K-25 Site in 1990 because of the termination of its original and primary mission.

In 1996, the site was renamed the East Tennessee Technology Park to reflect its mission of environmental restoration and management, and reindustrialization through leasing to and partnering with private industry. ETTP's goal is to reindustrialize and reuse site assets, such as facilities, equipment, materials, utilities, and trained workforce, by leasing vacated facilities and incorporating commercial industrial organizations as partners in the ongoing environmental restoration, D&D, waste treatment and disposal, and diffusion technology development activities. Figures 1 and 2 are an aerial view of ETTP and a site map.



Figure 1. Aerial View of East Tennessee Technology Park

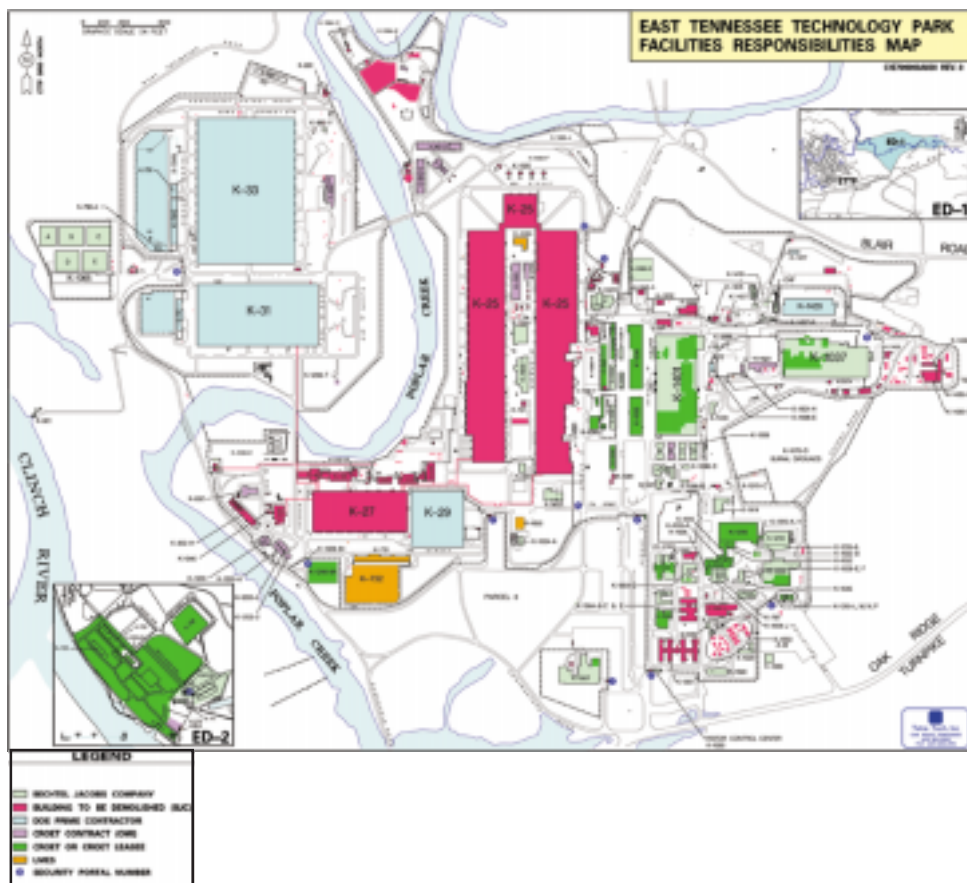


Figure 2. Site Map of East Tennessee Technology Park, DOE and Leased Facilities

During ETPP’s operating history, the process of enriching uranium for military and commercial applications generated enriched product, depleted uranium “tails,” and radioactive and non-radioactive wastes. In addition, other radioactive and non-radioactive materials, not associated with naturally occurring uranium, have been introduced to the site. These include transuranic elements (isotopes with atomic numbers greater than uranium) such as neptunium-237 and plutonium-239; fission products such as technetium-99; PCBs; toxic metals; and volatile organic compounds such as trichloroethene (TCE). These materials present differing levels of risk to workers and to the public depending upon their concentration, pathway of release, and method of exposure. Figure 3 shows the

historical process of uranium enrichment and its byproducts.

A number of organizations currently have programmatic and operating interests at ETPP. The relationship among these organizations is shown in Figure 4. Management of ES&H work for DOE at ETPP flows from the DOE Offices of Environmental Management and Nuclear Energy, Science and Technology to OR. OR has primary responsibility for managing contractor activities at the site; ensuring that operational, scientific, D&D, and ES&H missions are achieved; and supporting the reindustrialization effort. DOE employs a number of prime contractors at ETPP, including Bechtel Jacobs, BNFL, DRS, and M&EC.

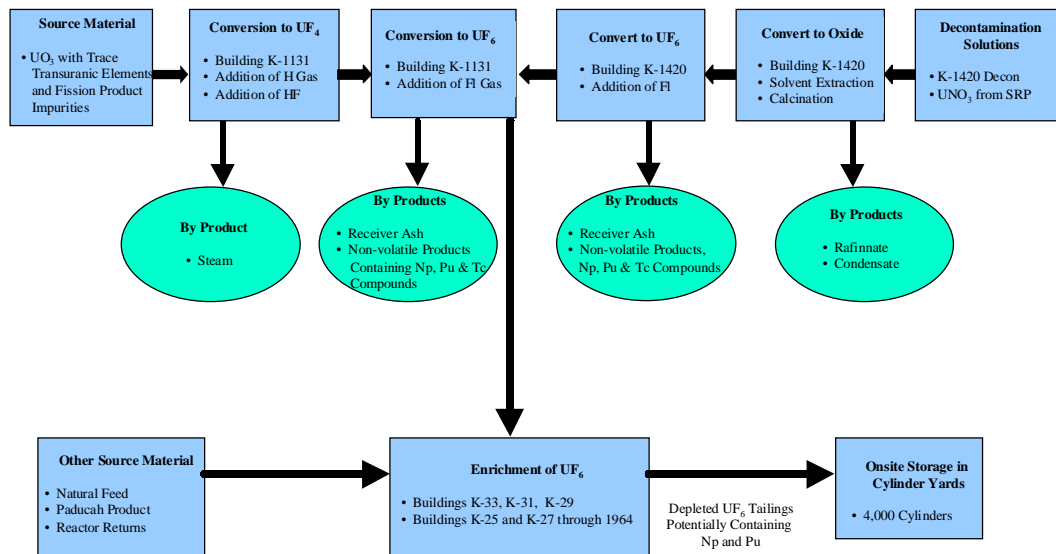


Figure 3. Schematic of Historical Uranium Enrichment Process

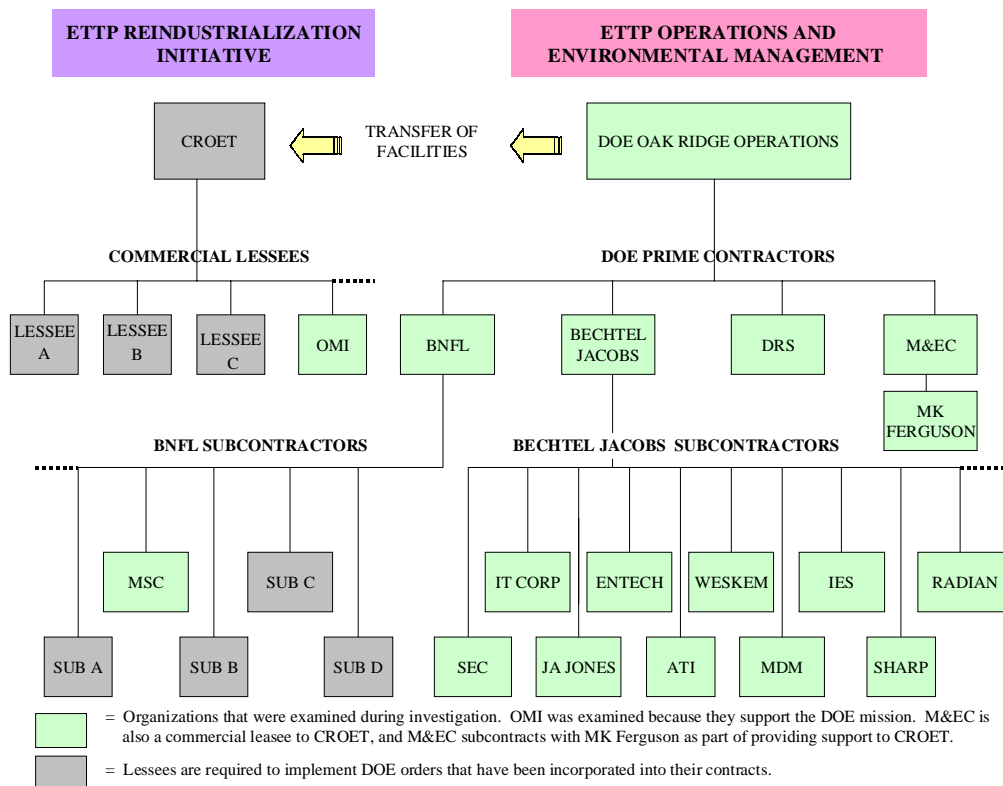


Figure 4. Organizational Relationships Among DOE, Prime Contractors, and Key Subcontractors at ETTP

Bechtel Jacobs was awarded a management and integration contract in December 1997; the scope of its contract includes environmental management, uranium programs, and support to the reindustrialization effort, which is under the purview of DOE. Under the terms of its contract, Bechtel Jacobs subcontracts the vast majority of its work. Among the many subcontractors providing support at ETTP are JA Jones (maintenance and site services), American Technologies Incorporated (facility management, surveillance, inspection, and testing), ENTECH (waste encapsulation activities in the K-25 building), IT Corporation (operation of the TSCA incinerator), Radian (operation of the Central Neutralization Facility), WESKEM (waste characterization, storage, and disposition), Canberra (non-destructive testing and analysis), Safety and Ecology Corporation or SEC (radiological control and industrial hygiene support), MDM Sampling Services (monitoring support), Integrated Environmental Solutions (operation of the gas cylinder project), Sharp (paving and fencing), and Technical and Field Engineering or TFE (training support).

BNFL conducts D&D of the K-29, K-31, and K-33 buildings, supports the overall reindustrialization effort, and performs material recycling and disposition as part of the Three Building D&D and Recycle project. In execution of its mission, BNFL uses MSC (a wholly owned subsidiary of BNFL) to perform monitoring, as well as a number of subcontractors. DRS performs D&D of Building K-1420 in anticipation of reindustrialization. Similarly, M&EC performs D&D of Building K-1200 in anticipation of reindustrialization. In execution of this activity, M&EC uses MK Ferguson to provide maintenance and construction services support.

The CROET mission (i.e., development of industrial sites) was not within the scope of this investigation, nor was the process of leasing facilities to commercial enterprises whose services are unrelated to the DOE mission. However, the activities of Operations Management International (OMI)—a CROET lessee—were examined because OMI's functions include grounds maintenance, maintenance of all outside utilities (except electrical), and operation of the steam plant. These activities support the DOE mission at ETTP.

1.3 Investigative Approach

The overall objectives of this investigation were to determine whether historical ES&H activities and controls were in accordance with the knowledge,

standards, and local requirements applicable at the time; whether any additional ES&H concerns have not been documented; and whether current work and safety management practices for DOE-controlled areas of ETTP are sufficient to protect workers, the public, and the environment.

Interviews were conducted with over 300 current and former employees, including DOE Headquarters, OR, and ETTP Site Office personnel; Bechtel Jacobs, BNFL, DRS, M&EC, and subcontractor managers, supervisors, and workers; and stakeholders. Nearly 200 of these interviews resulted from a solicitation that the investigation team placed in local newspapers requesting information on past Plant operations, ES&H practices, and specific events that could have affected worker and public health and safety and environmental protection. These interviews also provided the investigation team with a preliminary indication of the degree to which ES&H practices and controls were consistent with and appropriate to the standards of the day, both past and present. This information allowed the investigation team to identify certain ES&H practices for more detailed document review.

The investigation team conducted numerous facility and work area walkthroughs examining site operations, work practices, and hazard controls. Essentially all DOE-controlled ETTP facilities, waste and material storage areas, and grounds were visited by the investigation team. Many facilities and storage areas were examined multiple times. Job planning, maintenance, and operational activities were also observed to understand how work activities are planned and executed.

The investigation team collected 33 samples from groundwater wells, surface water sources, sediments, and soil (see Volume 2 of this report for more information). Samples were collected both inside and outside the perimeter security fence. Selected samples were evaluated for the presence of radioactive and non-radioactive contaminants. All samples were “split” or separated into two samples for running parallel tests, and samples were maintained under a strict chain of custody.

To supplement the interview, observation, and sampling processes, the investigation team reviewed thousands of current and historical documents, including plans, procedures, log books, assessments, analyses, reports, and correspondence. These reviews supplemented the information from interviews and clarified the chronology of events at ETTP. The investigation team also examined documents addressing past standards to provide a framework for understanding

ES&H requirements and expectations. Many records were obtained from ETP archives documenting past releases of radioactive and hazardous materials and their potential impacts on workers, the public, and the environment.

This extensive process for gathering information enabled the team to proceed in a structured fashion to (1) understand past conditions; (2) fully comprehend the issues being raised regarding past operations, past work practices, and management of legacy materials; (3) evaluate the effectiveness of actions taken by ETP to address ES&H issues; and (4) assess current conditions at ETP and their impact on worker and public health and safety, and the protection of the environment. Volume 1 addresses elements 1, 2, and 3; Volume 2 addresses element 4.

1.4 Data Considerations

The scope of this investigation required that the investigation team examine current as well as legacy data and information. This involved both the review and evaluation of archived material and current operations, as well as the assessment of recorded interviews documenting individuals' recollections of previous events and conditions. The investigation team recognizes the inherent difficulty of current and former workers' accurately recalling details related to activities and events happening up to and perhaps more than 50 years ago. While the interview solicitation indicated the team's desire to speak with personnel who were involved in a variety of functions at ETP, many individuals were self-selected for the interviews; that is, their participation resulted from their personal interest in the investigation. Accordingly, the team cross-checked information from multiple sources before making the judgments contained in this report.

The identification and review of historical documentation was a tedious and time-consuming process. Due to the volume of records and other documentation generated over almost 55 years, the investigation team made a "best effort" to locate and review all pertinent documentation. Documents were examined based on focused subject searches and targeted sampling. The range of operations and R&D activities conducted at ETP was far greater than those associated with Paducah and Portsmouth. Similarly, the volume of historic records retained in conjunction with the operation of ETP (and the predecessor K-25 Site) far exceeded the dimensions of those at the Paducah and Portsmouth sites. The investigation team faced a

variety of challenges associated with identifying, accessing, and reviewing ETP records. Records addressing the ES&H aspects of all ETP operations, programs, and R&D activities were not available. In addition, the sheer number of locations containing records related to past activities at ETP was significant. These included a variety of storage vaults maintained in onsite buildings, at other DOE sites on the Oak Ridge Reservation, at facilities in the City of Oak Ridge, and at locations outside Tennessee.

1.5 Report Structure

The results of this investigation are presented in two volumes to provide the reader with a comprehensive understanding of past and current activities at ETP and a thorough description of operational, maintenance, and environmental management practices and their effectiveness in minimizing impacts on workers, the public, and the environment. Volume 1 describes historical ES&H practices. Volume 2 presents an assessment of current ES&H programs. To ensure that the full range of information is provided in an understandable manner, each volume is organized into a series of discussions outlining various elements of ETP's operation in the context of when and how they were conducted.

Accordingly, Section 2 of this volume provides a historical overview and description of past activities at ETP, within a series of functional areas that summarize key operations relating to the safety and health of workers, the public, and the environment. The objective of Section 2 is to provide an overall understanding of the major ETP activities and to indicate how these activities may have changed over time. More detailed discussions of historical operational, environmental management, and line management and oversight practices are presented in the subsequent three sections.

Section 3 describes the hazards that historically existed at ETP; past operations and maintenance activities; practices used to identify, monitor, and control these hazards; and the effectiveness of these practices in addressing hazards. Similarly, Section 4 describes past environmental management practices at ETP and their effectiveness in mitigating impacts to the public and the environment. Finally, Section 5 reviews historical management and oversight practices and discusses employee relations.

Appendix A of Volume 1 outlines the radiological, chemical, and physical hazards present at ETP over

the years. Appendix B of Volume 1 summarizes the principal activities conducted at ETTP from 1943 to 1997 and provides a general assessment of the hazards presented by these activities, the controls used to mitigate the hazards, and the effectiveness of the controls. Appendix C provides a listing of historic treatment and disposal facilities. A separate, classified document contains a brief discussion of the operation of the barrier facility.

Volume 2 of this report documents current conditions at ETTP in terms of public and environmental protection, worker health and safety, and line oversight. This volume examines existing pathways for hazardous materials to be transported to the environment, the extent of contamination in groundwater and in surface waters, efforts undertaken by ETTP to control contamination, results from the sampling and analysis conducted by the investigation

team, the effectiveness of efforts to provide information to the public and other stakeholders, the nature and extent of risks that workers currently face at ETTP from both radiological and non-radiological hazards, the use of engineering and administrative controls to mitigate these hazards, the systems for planning and managing work, and the effectiveness of DOE and contractor management functions for ensuring protection of workers, the public, and the environment. The sheer number of subcontractor organizations required that the investigation team focus on those organizations that perform activities critical to the DOE ES&H mission at ETTP.

Appendix A of Volume 2 highlights significant issues in the implementation of current ES&H programs. The roster of the Office of Oversight investigation team is provided in Appendix B of Volume 2.